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Navy Case No. 73349

ELASTOMERIC LAUNCH SYSTEM FOR SUBMARINES

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties therefor.

CROSS REFERENCE TO RELATED PATENT APPLICATIONS

This patent application is co-pending with a related application having common ownership on the date of invention and filed on the same date as subject patent application entitled Flow-Through Elastomeric Launch System for Submarines by Ronald E. Waclawik and Scott D. Boyd further identified as Navy Case No. 74448.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The invention relates to an elastomeric launch system, and more specifically to a submarine low-noise projectile launching system.

(2) Description of the Prior Art

Existing submarine weapon launch systems are mechanisms which eject a torpedo or other device from a submarine by pumping

a working fluid, usually seawater, behind the device in the launch tube. The two most common launch devices are the ram pump and turbine pump ejection systems. Both systems are mechanically complex and tend to radiate noise into the surrounding fluid medium.

A ram pump launch apparatus converts potential energy from compressed air stored in a flask into working fluid kinetic energy. The ram pump system utilizes a massive piston apparatus to transfer sufficient working fluid, such as seawater, to launch a projectile. The mechanical friction and the mass of the piston act to reduce system efficiency and to produce substantial radiated noise. The ram pump system requires frequent maintenance because the system includes numerous mechanical components, in addition to the piston assembly.

A turbine pump launch apparatus also converts potential energy in the form of compressed air stored in a flask into kinetic energy of a working fluid. An air turbine drive unit is joined with a rotary impeller pump via a speed reduction unit. The turbine pump system is costly because of the complexity of the required mechanical components and is also noisy due to dynamic interaction of many of the system components.

In U.S. Patent No. 4,848,210, issued July 18, 1989 to Laurent C. Bissonnette, there is shown and described an elastomeric impulse energy storage and transfer system. The '210 system as shown is adapted to a torpedo launch system wherein an elastomeric bladder is distended by filling it with pressurized

working fluid. When an impulse of energy is desired the elastomeric bladder discharges the working fluid to quietly eject a projectile from the launch system into the surrounding liquid. The elastomeric bladder used is generally spherical containing, when expanded, volume sufficient to fill the launch tube and the launchway forward of the launch tube.

Following expulsion of seawater from the elastomeric bladder, a low pressure region forms at the mouth of the launch tube because of the finite nature of the fluid volume available in the bladder and the competing momentum of the fluid exiting the launch tube. This low pressure region is undesirable because it causes excessive noise due to cavitation. To prevent the pressure differential and the noise associated therewith, additional seawater must be available to the launch tube after the elastomeric bladder has been discharged.

SUMMARY OF THE INVENTION

Accordingly, it is a general purpose and object of the present invention to provide a quiet, even flowing launch system for submarines.

A further object of the invention is to provide a weapon launch system which, after firing, does not create additional noise because of a low pressure region forming at the mouth of the launch tube.

Still another object is that the system be simple, reliable and low in cost.

With the above and other objects in view, as will hereinafter appear, a feature of the present invention is the provision of an apparatus for providing pressurized liquid to a launch tube for launching projectiles into a liquid medium. The device comprises an elastomeric bladder disposed inside a cylindrical bypass tube. The forward end of the bypass tube is open to the liquid medium, and the aft end of the tube is hydraulically connected to the launch tube. The elastomeric bladder is externally of generally cylindrical shape and has an open aft end, a closed forward end and a side wall of varying thickness. The open end of the bladder is hydraulically connected to a valve. The valve acts to control charging of the bladder and discharge of the bladder. The bladder expands to contact the wall of the bypass tube when the bladder is pumped full of pressurized seawater. On expanding, the thinnest portion of the bladder contacts the wall first. Ultimately the whole bladder will act to seal the bypass tube by contact with the bypass tube wall to prevent the external liquid medium from communicating with the launch tube through the bypass tube. Upon vehicle launch pressurized liquid is provided from the elastomeric bladder through the valve to the launch tube. The bladder returns to its original shape after discharge breaking contact with the bypass tube wall, and liquid is allowed to flow through the bypass tube into the launch tube to prevent cavitation from occurring at the launch tube breech.

The above and other features of the invention, including various novel details of construction and combinations of parts, will now be more particularly described with reference to the accompanying drawings and pointed out in the claims. It will be understood that the particular device embodying the invention is shown by way of illustration only and not as a limitation of the invention. The principles and features of the invention may be employed in various and numerous embodiments without departing from the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention and many of the attendant advantages thereto will be readily appreciated as the invention becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

FIG. 1 is a diagrammatic view of the bow of a submarine cut away to display the launch device of the current invention as set for charging;

FIG. 2A is a detail view showing the fluid flow through the inventive device during charging;

FIG. 2B is a detail view showing the configuration of the inventive device after charging;

FIG. 2C is a detail view showing the fluid flow through the inventive device during launch; and

FIG. 2D is a detail view showing the fluid flow through the inventive device immediately after launch.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 there is shown diagrammatic view of the bow of a submarine cut away to display the launch mechanism. The launch mechanism of the current invention is disposed within the hull of a submarine **10**. Directions will be referred to in the ensuing drawings with references to forward being toward the bow of submarine **10** and references to aft being toward the rear of submarine **10**; however, directions provided herein should not be construed to limit the invention to the specified orientation. The launch mechanism comprises an elastomeric bladder **12** mounted within a cylindrical bypass tube **14**. Bladder **12** is made from Neoprene rubber, urethane, natural rubber or the like. Bypass tube **14** is a rigid cylinder with the forward end open to a free flood sea chest **16** and the aft end open to an impulse tank **18**. Sea chest **16** is open to seawater at the same pressure as the outside of submarine **10**. Elastomeric bladder **12** is mounted in bypass tube **14** by a spyder **22**. Spyder **22** is a support structure having an inner flow aperture **22a** surrounded by a plurality of outer flow apertures **22b**. Spyder **22** suspends bladder **12** at the center of bypass tube **14** and allows hydraulic communication between bladder **12** and impulse tank **18** through inner flow

aperture **22a**. Flow between bypass tube **14** and impulse tank **18** occurs around the outside of bladder **12** through outer flow apertures **22b**.

Impulse tank **18** is hydraulically connected to tube slots **24** in the walls of a launch tube **26** behind a device to be launched, such as a torpedo **28**. Torpedo **28** is loaded in launch tube **26** through a breech valve **29**. Impulse tank **18** provides a hydraulic impulse behind torpedo **28** to expel it from tube **26** via a muzzle valve **30**.

Bladder **12** is substantially cylindrical having a closed forward end **12a** positioned toward the open end of bypass tube **14** and an open aft end **12b** positioned toward spyder **22**. The wall of bladder **12** is not uniformly thick. Aft end **12b** is thinner than the forward end **12a**. Upon charging, thinner aft end **12b** of bladder **12** will first expand to contact bypass tube **14**. While bladder **12** is discharging, aft end **12b** is the last part of bladder **12** to contact bypass tube **14**. The material and thickness of bladder **12** are selected to provide the desired impulse profile. Open aft end **12b** is in communication with a firing valve **32**.

Firing valve **32** is positioned in hydraulic communication with elastomeric bladder **12**, impulse tank **18**, bypass tube **14**, and a seawater inflow tube **34**. Firing valve **32** is cylindrical with a movable piston **32a** disposed within a valve cylinder **32b**. Piston **32a** is postionable by shipboard hydraulics **36** connected to a control rod **32c**. To allow use of seawater to charge bladder **12**,

a charge sea valve **38** is provided in communication with a pump **40**. Pump **40** is joined to a charge shut off valve **42** which is in communication with seawater inflow tube **34**. Hydraulics **36**, pump **40**, and valves **38**, **42** are actuated on command from control circuitry **43**.

FIG. 2A, 2B, 2C and 2D show fluid flows through the elastomeric launch system during different stages of the launch process. In FIG. 2A, 2B, 2C and 2D, the flow of seawater is designated generally by flow arrows **44**. Firing valve **32** has a charge position shown in FIG. 2A and 2B, and a firing position shown in FIG. 2C and 2D. FIG. 2A illustrates fluid flow with valve **32** in charge position. In FIG. 2B firing valve **32** remains in the charge position and shut off valve **42** is closed to seal pressure within elastomeric bladder **12**. In FIG. 2C firing valve **32** is shown shifted to the firing position to allow hydraulic communication between elastomeric bladder **12** and impulse tank **18**. Flow arrows **44** show the initial flow of seawater from elastomeric bladder **12** through valve cylinder **32b** into impulse tank **18**. FIG. 2D shows fluid flow around valve cylinder **32b** after the initial impulse of the launch. Flow arrows **44** show fluid flow through spyder **22** and into impulse tank **18**.

In FIG. 2A, there is shown the inventive device with valve **32** positioned to allow charging of bladder **12** from seawater inflow tube **34**. In this position of valve **32**, open aft end **12b** of bladder **12** is sealed from communication with impulse tank **18**. As shown in FIG. 1, charge sea valve **38** is opened to allow pump

40 to pump seawater through opened charge shut off valve 42 into elastomeric bladder 12 via inner flow aperture 22a. When the desired pressure is attained, charge shut off valve 42 and sea valve 38 are closed.

Referring now to FIG. 2B, there is shown the inventive device in its charged state. In this position of valve 32, aft end 12b of bladder 12 is completely sealed by valve 32 and shut off valve 42. Elastomeric bladder 12 is deformed radially to contact bypass tube 14. The contact between bladder 12 and the interior surface of bypass tube 14 seals tube 14 and prevents seawater from entering impulse tank 18 through outer flow apertures 22b, bypass tube 14, and sea chest 16.

Referring now to FIG. 1 and FIG. 2C, when torpedo 28 is ready for launch, firing valve 32 is shifted to firing position to allow pressurized seawater to flow from elastomeric bladder 12 through inner flow aperture 22a into impulse tank 18. Pressure in impulse tank 18 is transmitted to launch tube 18 to eject torpedo 28 therein. Thinner aft end 12b is the last portion of bladder 12 to contract thus preventing the seawater in impulse tank 18 from escaping through spyder 22 and bypass tube 14.

Referring now to FIG 2D, as the seawater in elastomeric bladder 12 and impulse tank 18 is discharged, aft end 12b will contract away from bypass tube 14. At this stage, the pressure in impulse tank 18 will be less than the pressure in sea chest 16 and seawater will flow through bypass tube 14 around deflated elastomeric bladder 12 through spyder 22 outer flow apertures 22b

and then to launch tube **26**. Seawater flowing through impulse tank **18** avoids formation of a low pressure region at the mouth of launch tube **26** by providing a gradual reduction of seawater flow thereby filling the area behind launched torpedo **28**. See FIG. 1.

The primary advantage of the present invention over elastomeric launchers such as the launcher shown in U.S. Patent No. 4,848,210 is that the launcher of the present invention prevents cavitation at the breech of the launch tube after launching a device. Cavitation is prevented by providing a bypass cylinder which allows seawater to flow around the elastomeric bladder and into the launch tube after firing. During charging, the elastomeric bladder seals against the bypass tube and prevents transmission of seawater to the launch tube.

What has thus been described is an elastomeric launch system with seawater flow through a bypass tube allowing a device to be launched from a launch tube with reduced noise. Noise is reduced by providing fluid flow through the launch tube after the launch.

Obviously many modifications and variations of the present invention may become apparent in light of the above teachings. For example: any wall portion of the elastomeric bladder can be thinned to seal against the interior surface of the bypass tube; the impulse tank can be omitted by piping seawater directly to the launch tube from the apparatus; and a compact three way valve assembly can be used in place of the firing valve and shut off valve combination.

In light of the above, it is therefore understood that the invention may be practiced otherwise than as specifically described.

Navy Case No. 73349

ELASTOMERIC LAUNCH SYSTEM FOR SUBMARINES

ABSTRACT OF THE DISCLOSURE

An apparatus for providing a pressurized liquid to a launch tube for launching projectiles into a liquid medium. The device comprises an elastomeric bladder disposed inside a cylindrical bypass tube. The forward end of the bypass tube is open to the liquid medium, and the aft end of the tube is hydraulically connected to the launch tube. The elastomeric bladder is externally of generally cylindrical shape and has an open aft end, a closed forward end and a side wall of varying thickness. The open end of the bladder is hydraulically connected to valves which act to control charging of the bladder and firing of the bladder. The bladder expands to contact the wall of the bypass tube when the bladder is filled with pressurized seawater. Ultimately the whole bladder will act to seal the bypass tube by contact with the bypass tube wall to prevent the external liquid medium from communicating with the launch tube through the bypass tube. Upon vehicle launch pressurized liquid is provided from the elastomeric bladder to the launch tube. The bladder returns to its original shape after discharge breaking contact with the bypass tube wall, and liquid is allowed to flow through the bypass tube into the launch tube to prevent cavitation from occurring at the launch tube breech.

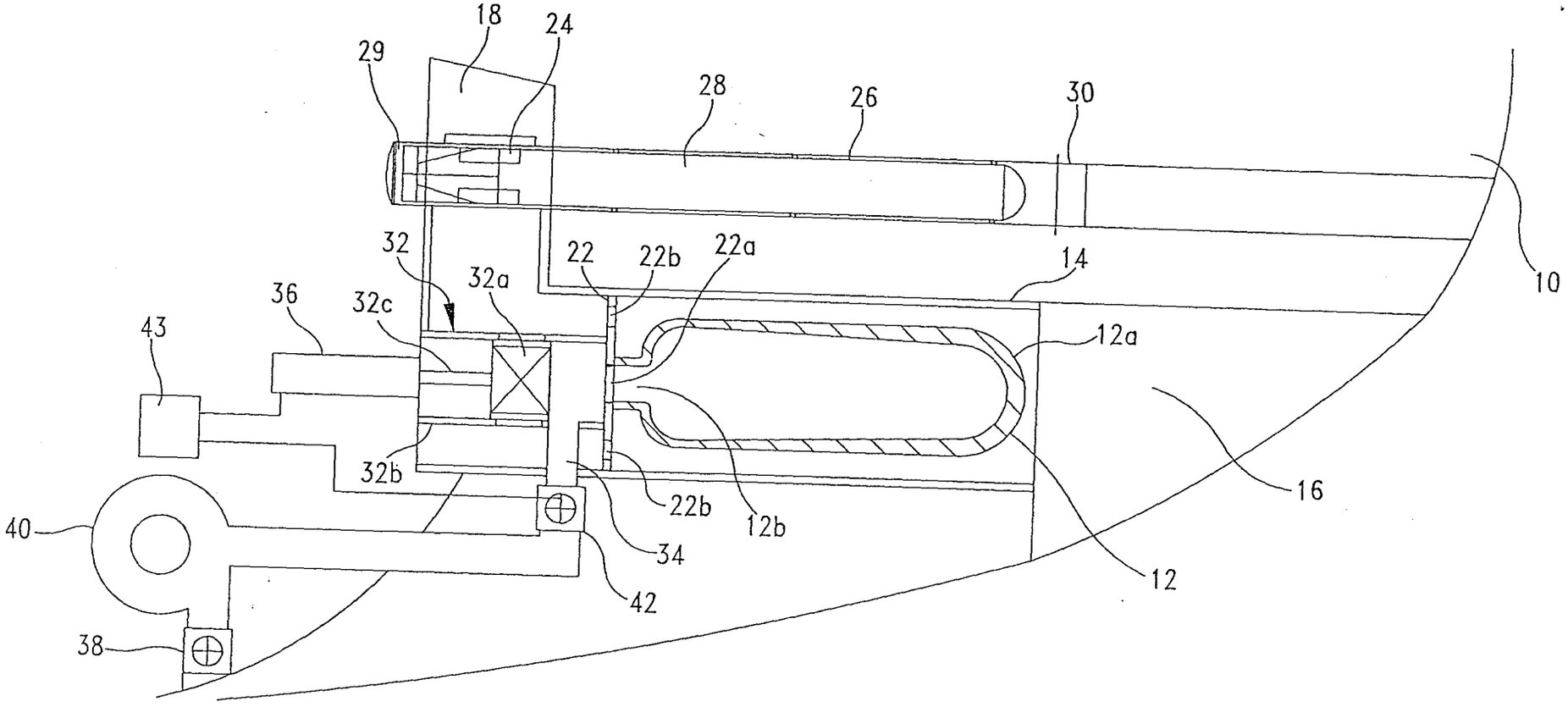
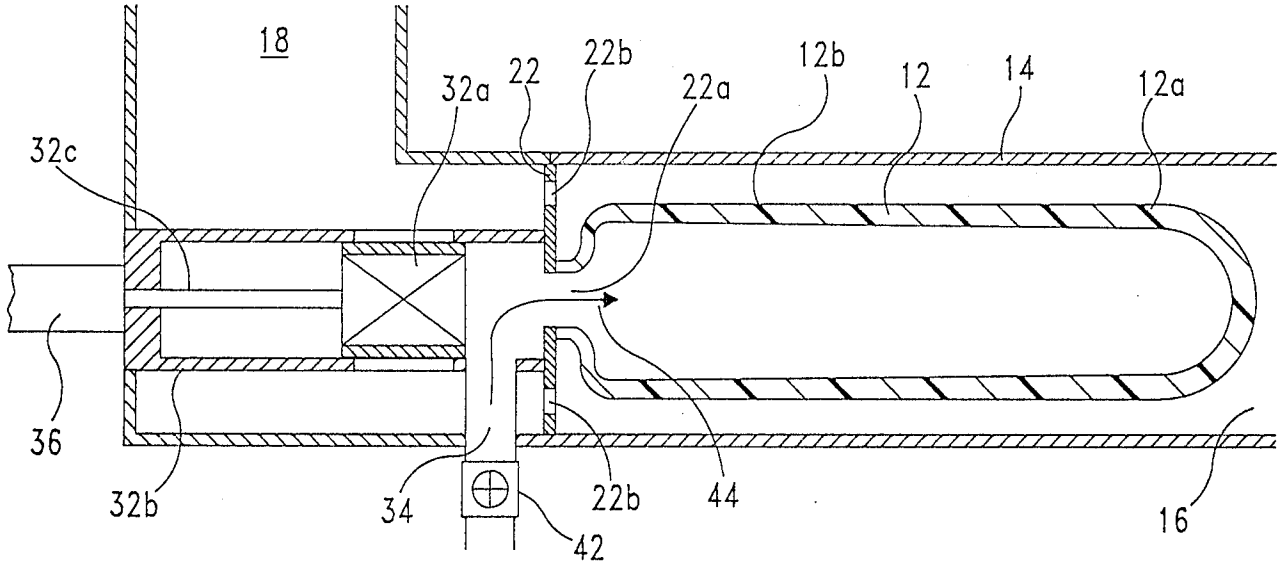

18
24
29
28
26
30
10
32
22
22b
22a
14
32a
36
32c
43
12a
16
32b
22b
12b
40
34
12
42
38

FIG. 1


18
32a
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22b
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14
12a
32c
36
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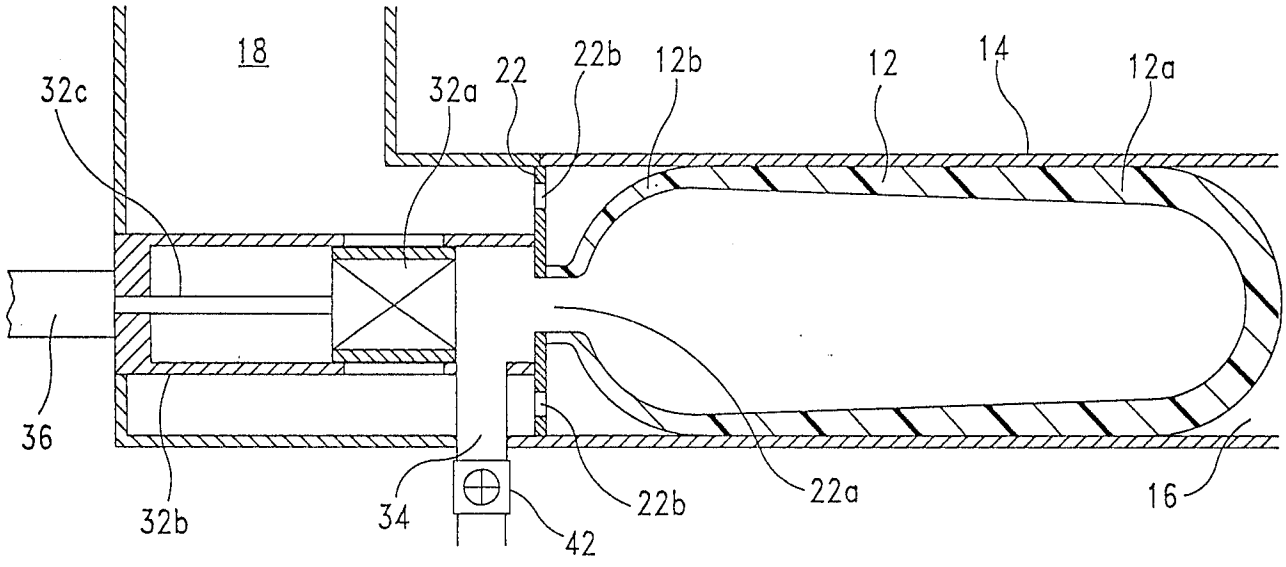
34
22b
44
42
16

FIG.2A


18
32c
32a
22
22b
12b
12
14
12a
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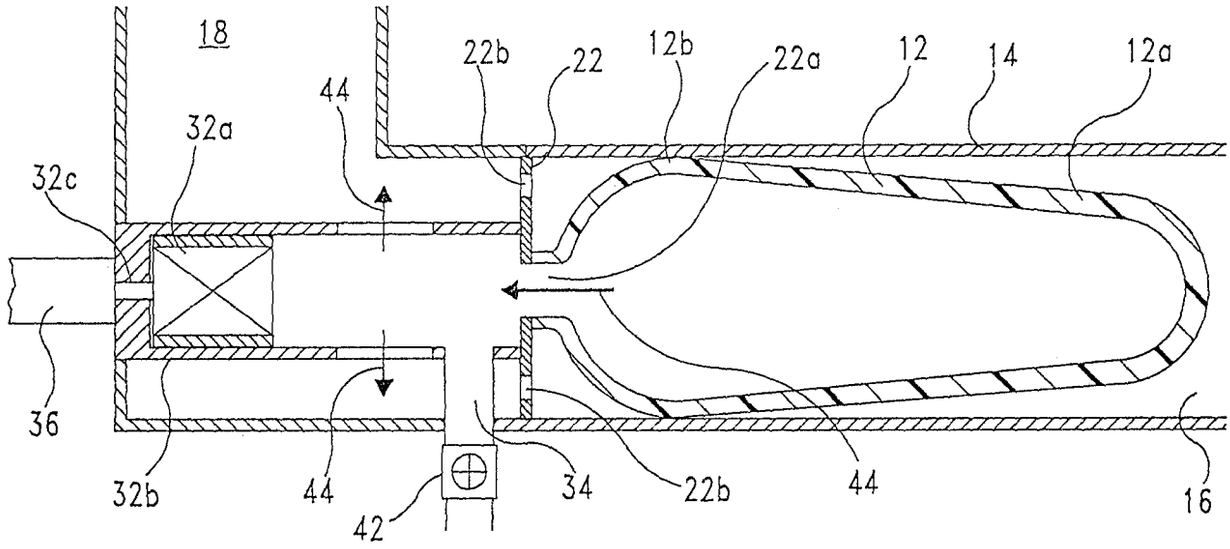
22b
22a
42
16

FIG.2B


18
22b
22
12b
22a
12
14
12a
44
32a
32c
36
32b
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42
34
22b
44
16

FIG.2C

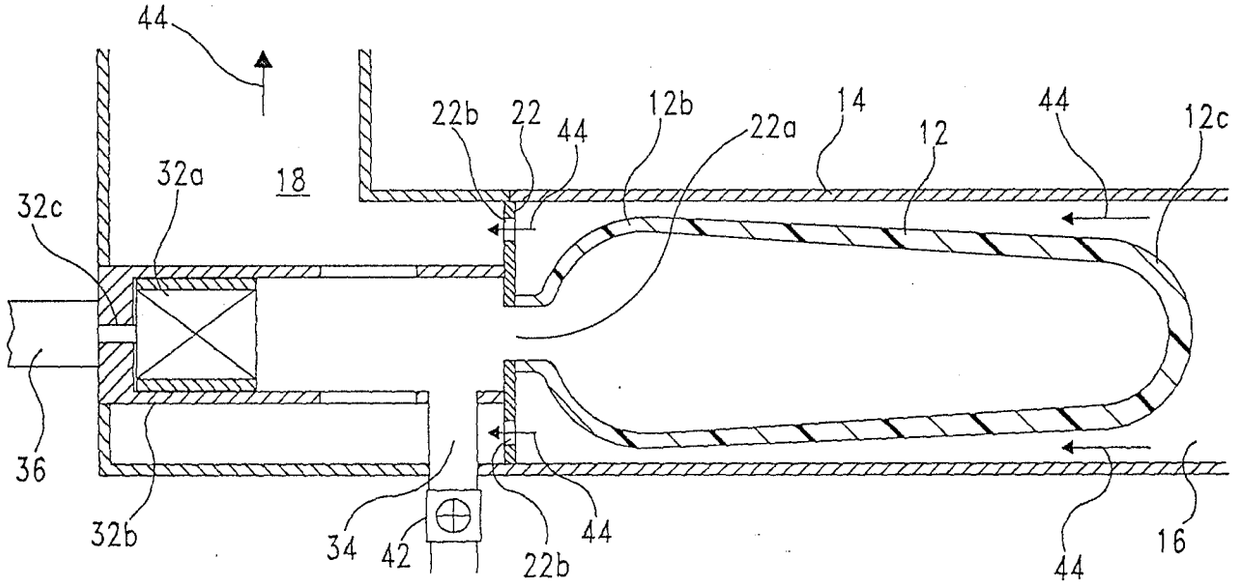
44
22b
22
44
12b
22a
14
12
44
12c
32a
18
32c
36
32b
34
42
22b
44
44
16

FIG.2D